

First record of *Prozercon plumosus* Călugăr, 2004 (Acari, Mesostigmata, Zerconidae) from Slovakia

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Abstract. *Prozercon plumosus* Călugăr, 2004, a species of mesostigmatic mite (Acari), is reported from Slovakia for the first time. Our new record, which originates from western Slovakia, extends the known distribution of *P. plumosus*. We include a key to *Prozercon* Sellnick, 1943 species that are similar to *P. plumosus*.

Key words. Europe, mites, new record, soil fauna

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INTRODUCTION

Mites of the family Zerconidae, which can be found in leaf litter, moss, soil, and decomposing organic detritus, are distributed throughout the whole northern hemisphere (Mašán and Fend'a 2004; Sikora 2014).

Knowledge of zerconids in Slovakia has benefited from the work of Dr. Věra Halašková, who was one of the main acarological researchers on this family of mites in the second half of the 20th century and who described many new species in former Czechoslovakia (Halašková 1963a, 1963b, 1964, 1969a, 1969b, 1977, 1979). Other researchers later observed zerconid mites in bird nests (Fend'a et al. 1998; Krumpál et al. 1998; Fend'a and Lengyel 2007; Fend'a 2010; Fend'a and Schniererová 2010).

The most complete work on Slovak zerconids is that by Mašán and Fend'a (2004), who provided the information on the ecological requirements and morphology of zerconids, described new species, and developed a determination key to the Zerconidae of Slovakia. As stated by Mašán and Fend'a (2004), there are four known zerconid genera: *Parazercon* Trägårdh, 1931, *Mixozzercon* Błazsak, 1975, *Prozercon* Sellnick, 1943, and *Zercon* C.L. Koch, 1836. So far, 12 species of *Prozercon* are known in Slovakia, of which six are locally common: *P. carpathofimbriatus* Mašán & Fend'a, 2004, *P. carsticus* Halašková, 1963, *P. fimbriatus* C.L. Koch, 1839, *P. kochi* Sellnick, 1943, *P. sellnicki* Halašková, 1963, and *P. traegardhi* (Halbert, 1923); and six species are rare: *P. carpathicus* Balan & Sergienko, 1990, *P. kunsti* Halašková, 1963, *P. lutulentus* Halašková, 1963, *P. rafalskii* Błazsak, 1971, *P. similis* Balan, 1992 and *P. verruciger* Mašán & Fend'a, 2004.

Many *Prozercon* species are very similar, and, thus, we have included a determination key here for a few selected species that have the podonotal setae similar in shape—where most of the setal pairs are pilose—to *Prozercon plumosus* Călugăr, 2004, which we report herein as new from Slovakia.

METHODS

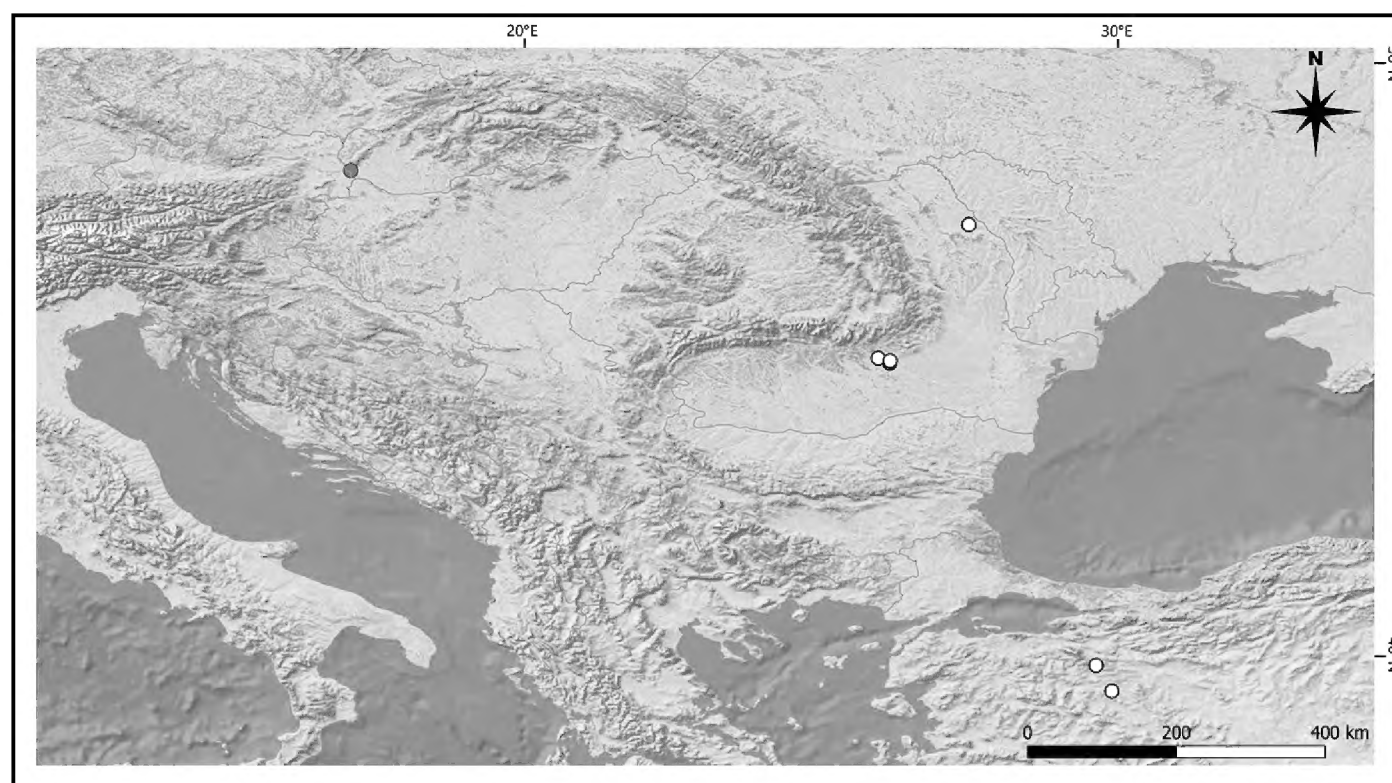
Mites were collected from samples of soil and litter from a pine stand (*Pinus* L. sp.). The samples were taken in August 2021. Soil fauna was extracted using Berlese-Tullgren funnels and stored in 70% ethanol. Mites were separated using a stereo microscope Leica S9E and mounted using chloralhydrate-based medium Liquido de Swan. Specimens were identified under the laboratory microscope Zeiss Axioscope 5 according to Mašán and Fend'a (2004) and Călugăr (2004). Photographs and measurements were taken with Zeiss AxioCam 208 color and ZEN v. 3.4., and all measurements are in micrometers. The distribution map of the species was made with QGIS v. 3.32.1 (QGIS 2024). The localities of distribution are shown in Figure 1. The examined specimens are deposited at the Department of Zoology at Faculty of Natural Sciences of Comenius University in Bratislava, Slovakia (FNS-UK KZO, curator: M. Jandík).



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Figure 1. Distribution of *Prozercon plumosus* Călugăr, 2004. White dots are records from Romania and Türkiye, the red dot is the new record from Slovakia. Orange lines are borders of countries.



RESULTS

Family Zerconidae G. Canestrini, 1891

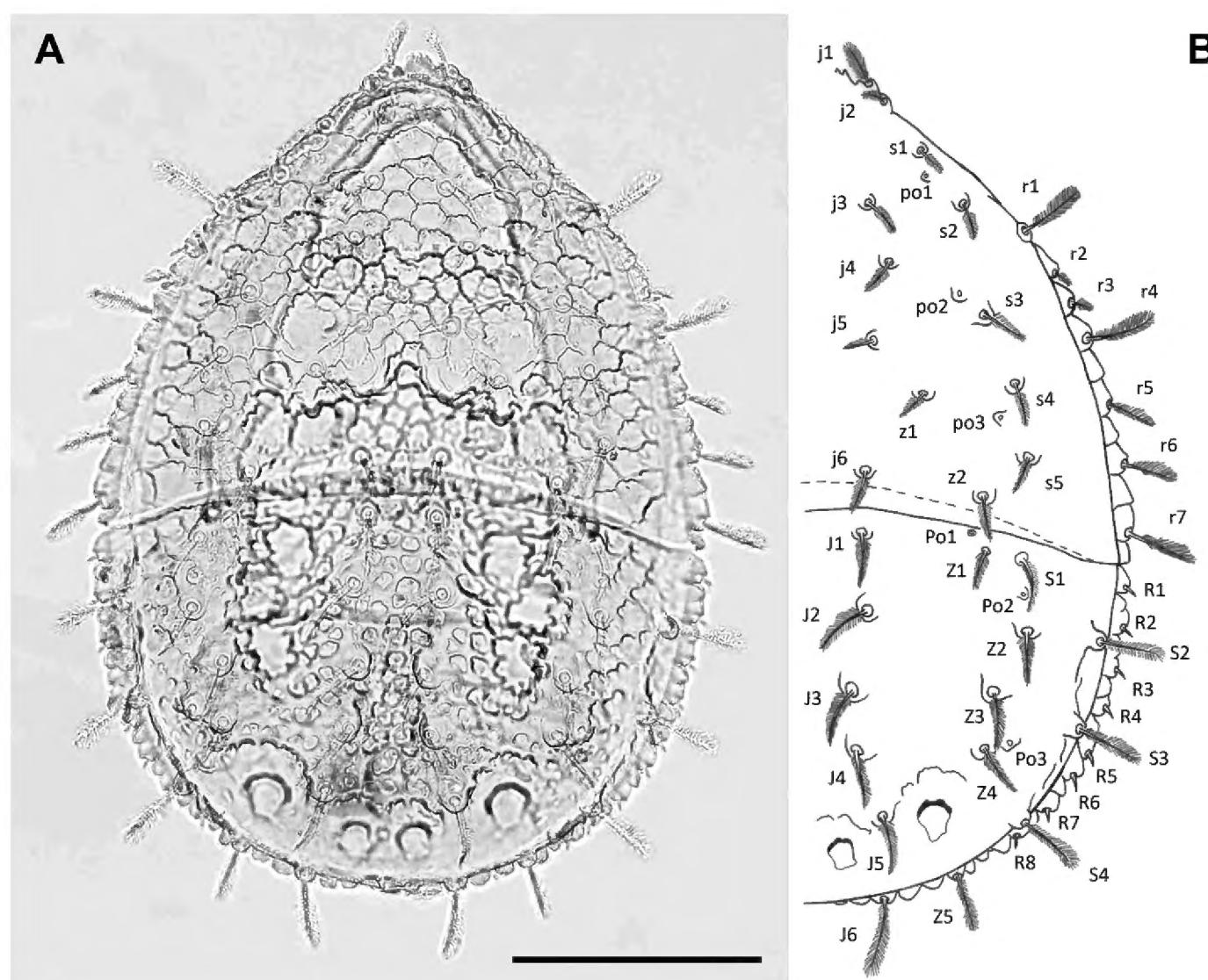
Prozercon plumosus Călugăr, 2004

Figures 1–3A, 4

Material examined. SLOVAKIA – BRATISLAVA REGION • Bratislava; 48.1498°N, 017.0707°E; 170 m alt.; 18.VIII.2021; L. Švecová leg.; soil and needle litter under pine stand; inner block/atrium of the Faculty of Natural Sciences of Comenius University in Bratislava (Figure 4); 24 ♀; FNS-UK KZO 01-K-1 • Bratislava; 48.1498°N, 017.0707°E; 170 m alt.; 25.VIII.2021; L. Švecová leg.; soil sample under a rat in advanced decay; inner block/atrium of the Faculty of Natural Sciences of Comenius University in Bratislava (Figure 4); 1 ♀; FNS-UK KZO 01-V-3.

Distribution. This species is known from several localities in Romania: from oak-forest soil and leaf litter in Iași County (Mârzești) and from oak and hornbeam forests, as well as from ash groves and forest in Prahova

Figure 2. *Prozercon plumosus* Călugăr, 2004 **A.** Dorsal view. **B.** Dorsal chaetotaxy. Scale bar: 100 µm.



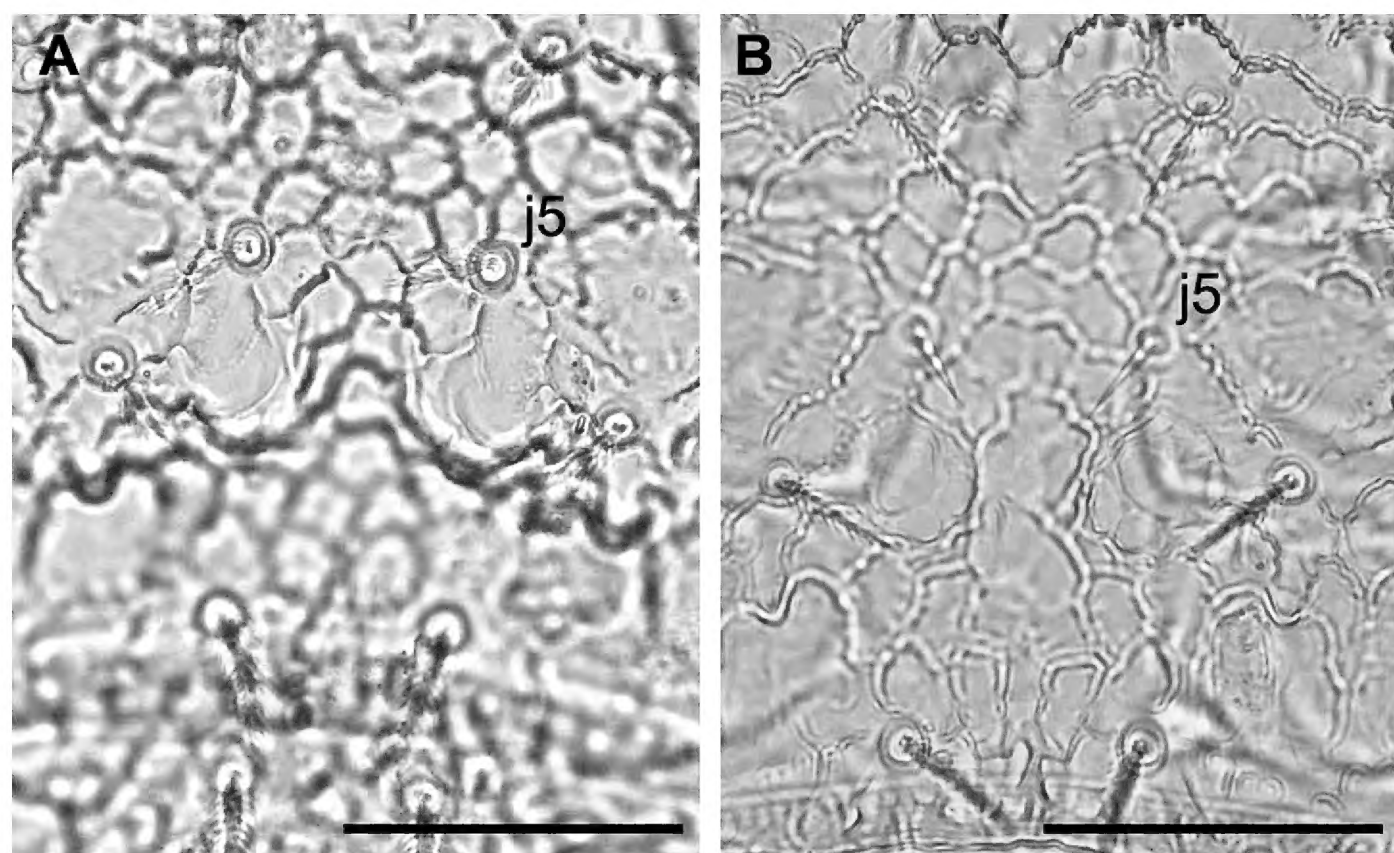
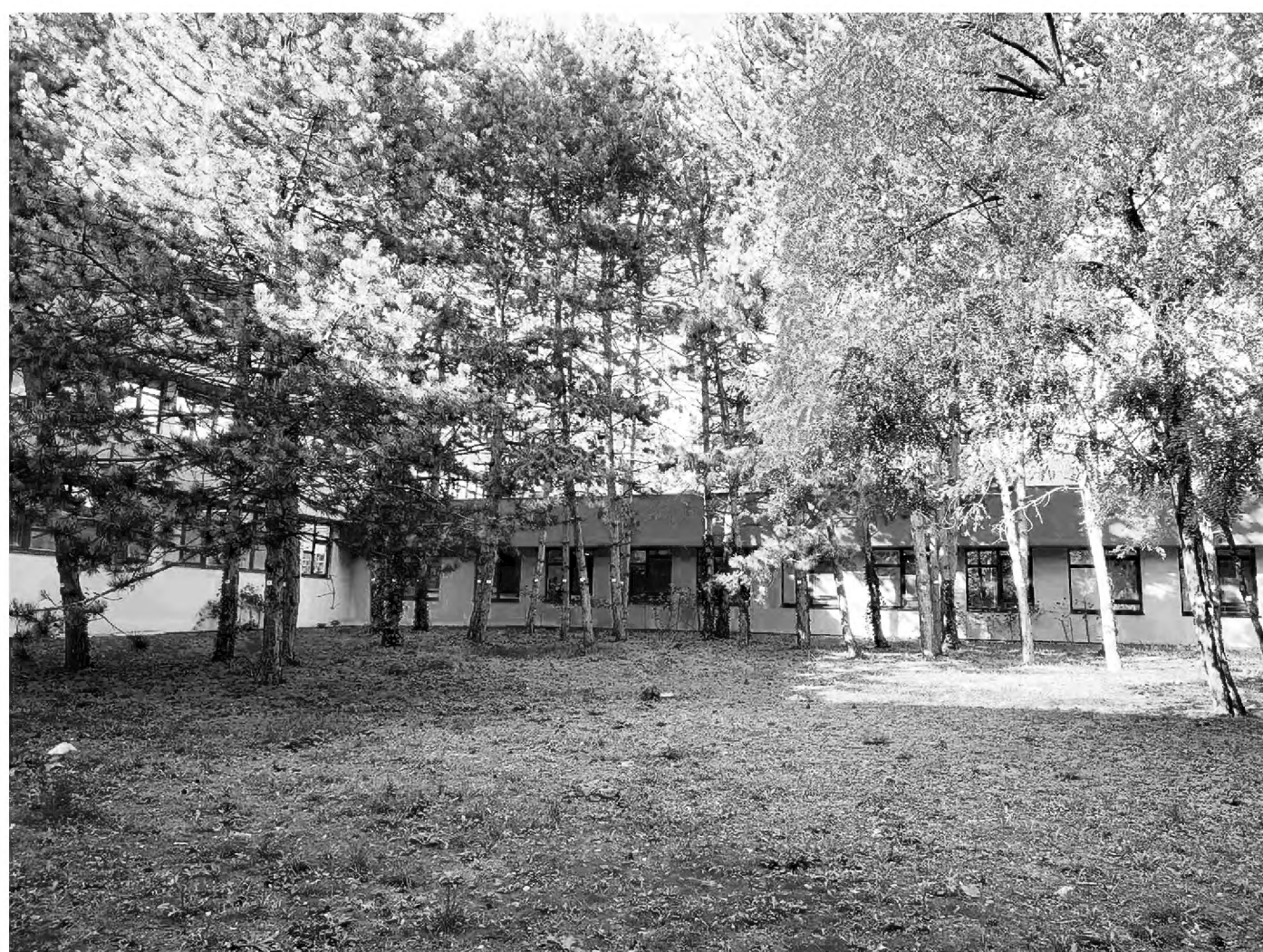


Figure 3. Detail on *j5* setae **A.** *Prozercon plumosus* Călugăr, 2004: plumose setae. **B.** *Prozercon treagardhi* (Halbert, 1923): smooth, needle-like setae. Scale bar: 50 µm.

Figure 4. The locality of the new record, the pine stand in atrium of Faculty of Natural Sciences of Comenius University in Bratislava.



County (Păuleşti, Dârvari, Valea Călugărească) (Călugăr 2004). In Türkiye, it was found in Kütahya Province, in soil and litter under pine trees in Güveççi (Centre) and in pine and beech forest in Sefa (Domanic District) (Duran et al. 2017; Figure 1).

Identification. *Female.* Idiosoma. On podonotum, all setae are pilose. Setae *j2*, *r2*, and *r3* are shorter than the other setae of podonotum. Setae *r1* and *r4–r7* are densely plumose and brush-like. All opisthonotal setae, except R-rows, are pilose. Setae *J1–5*, *Z1–4*, and *S1* similar in appearance. Setae *J6*, *Z5*, and *S2–S4* densely plumose and brush-like, and only setae *S2–4* reaching beyond edge of opisthonotum. Lateral sides of opisthonotum are reticulate and the rest of opisthonotum is covered by alveolar microsculpture. Dorsal depressions are halfmoon-shaped with their axes parallel to that of the body. On ventral side, lateral ends of peritremal shields reach to *R2–3* and an adgenital shield is absent. Length of opisthonotal setae and distances between them in the same row are listed in measurements of the specimens. On the opisthonotum, pore *Po1* located in anterior position, oblique to the insertion of seta *Z1*. Pore *Po2* lies outside the line connecting setae *S1–Z2*, closer to *Z2*. Pore *Po3* lies outside the line connecting setae *Z3–Z4*, near *Z4*. Pore *Po4* located on the line connecting *S4–Z5* near *S4*.

Measurements of the specimens (6♀) (Figure 2). Idiosoma length 342.51 µm (331.38–350.19), width 253 µm (240.5–256.92). Setae *J1* 25.51 µm (22.32–28.33), *J2* 29.22 µm (24.89–33.19), *J3* 30.3 µm (25.83–34.01), *J4*

27.67 µm (22.92–31.6), J5 24.77 µm (20.06–29.27), J6 29.1 µm (27.86–30.54), Z1 16.43 µm (13.13–18.73), Z2 21.82 µm (16.22–25.58), Z3 23.86 µm (16.16–28.35), Z4 25.63 µm (18.2–29.99), Z5 22.88 µm (20.72–24.99), S1 19.84 µm (13.89–23.14), S2 27.04 µm (24.33–29.26), S3 27.74 µm (25.45–29.16), S4 27.08 µm (21.92–30.39). Distance between setae J1–J2 32.48 µm (28.63–35.17), J2–J3 34.77 µm (32.34–36.63), J3–J4 26.29 µm (24.78–29.56), J4–J5 26.1 µm (21.04–29.32), J5–J6 23.77 µm (20.07–37.09), J6–J6 61.01 µm (60.24–62.81), Z1–Z2 38.17 µm (35.53–43.61), Z2–Z3 30.94 µm (24.9–35.65), Z3–Z4 26.79 µm (23.91–30.88), Z4–Z5 41.05 µm (33.73–50.72), S1–S2 19.84 µm (34.93–23.14), S2–S3 40.26 µm (35.47–41.05), S3–S4 43.1 µm (39.5–46.31).

Similar species. The shape of the podonotal setae is similar to that of many other *Prozercon* species. Only in *Prozercon graecus* Ujvári, 2011 and *P. plumosus* are setae j5 pilose. *Prozercon graecus* differs in the position of pores Po1, which lie outside of setae Z1; in the weakly sclerotised band on sternal shield between setae st1 and st2, and in the length of the lateral end of the peritremal shield. The closest morphologically related species in Slovakia is *P. traegardhi*, which is similar to *P. plumosus* with the exception of setae j5, meaning that *P. traegardhi* has a smooth j5 and *P. plumosus* has a pilose j5 (Figure 3).

Determination key. For better identification we include a key of selected *Prozercon* species with similar shape of the podonotal setae, which are mostly pilose.

1. Opisthonotal setae of R-row different in shape 2
 - Opisthonotal setae of R-row similar in shape 7
2. R1 and R2 pilose, other setae of R-row smooth *halaskovae* Petrova, 1977
 - R1 is pilose, other setae of R-row smooth 3
3. Opisthonotal setae S3 absent *yavuzi* Urhan, 1998a
 - Opisthonotal setae S3 present 4
4. Sternal shield divided into two parts *bisternalis* (Błaszak, 1979)
 - Sternal shield undivided 5
5. Pores Po3 outside line connecting Z3–Z4 *kunsti* Halašková, 1963
 - Pores Po3 inside line connecting Z3–Z4 6
6. Z2 and Z3 extend slightly beyond insertion of following setae; insertion of S2 closer to body edge; S2 and S3 straight, distally broadening and brush-like *norae* Ujvári, 2011
 - Z2 and Z3 do not extend beyond insertion of following setae; insertion of S2 further from edge of body, S2 and S3 bent and distally pointed *morazae* Ujvári, 2011
7. Opisthonotal setae of R-row smooth 8
 - Opisthonotal setae of R-row pilose 17
8. Dorsal depressions different in size *sellnicki* Halašková, 1963
 - Dorsal depressions equal in size 9
9. Peritrematal setae p1 pilose 10
 - Peritrematal setae p1 smooth 12
10. Podonotal setae j5 smooth *satapliae* Petrova, 1977
 - Podonotal setae j5 pilose 11
11. Postero-lateral tips of peritrematal shield reaching R2; pores Po1 inside setae Z1; sternal shield well sclerotised *plumosus* Călugăr, 2004
 - Postero-lateral tips of peritrematal shield reaching between R6–R7; pores Po1 outside Z1 setae; sternal shield with weakly sclerotised band between setal pairs st1 and st2 present *graecus* Ujvári, 2011
12. Setae S3 absent *denizliensis* Urhan, 2002
 - Setae S3 present 13
13. Setae S1 smooth *tragardhisimilis* Solomon, 1984
 - Setae S1 pilose 14
14. Setae J1 reaching insertion of J2 *tragardhi* (Halbert, 1923)
 - Setae J1 not reaching insertion of J2 15
15. Sternal shield divided into two parts *blaszaki* (Urhan & Ayyıldız, 1996a)
 - Sternal shield undivided 16
16. Postero-lateral tips of peritrematal shield reaching R2–R3; J and Z setae situated on enlarged setal bases *bulbiferus* Ujvári, 2011
 - Postero-lateral tips of peritrematal shield reaching R4–R5; basis of J and Z setae of normal size *sultani* Duran & Urhan, 2015
17. Peritrematal setae p1 pilose 18
 - Peritrematal setae p1 smooth 22
19. An additional unpaired seta (Jx4) between the setae J4–J4' present 19
 - An additional unpaired setae between J–J' setal row absent 20

- 20. Setal pairs S2 and S3 absent *kurui* Urhan, 1998b
 - Setal pair S3 absent *bircanae* Urhan, 1998b
- 21. Postero-lateral tips of peritrematal shield reaching beyond R5 *orhani* Urhan & Ayyildiz, 1996b
 - Postero-lateral tips of peritrematal shield not reaching beyond R5 21
 - Postero-lateral tips of peritrematal shield reaching between R3–R4; S2 not reaching beyond body edge *umidicola* Urhan, 2002
 - Postero-lateral tips of peritrematal shield reaching between R2–R4; S2 reaching beyond body edge *kamili* Urhan & Ayyildiz, 1996b
- 22. Setae S1 smooth *murati* Urhan, 2013
 - Setae S1 pilose 23
- 23. Setal pair S3 absent *erdogani* Urhan, 2010
 - Setal pair S3 present 24
- 24. Pores Po3 outside Z-row 25
 - Pores Po3 inside Z-row 26
- 25. Setae J1 reaching insertion of J2, j3 smooth *martae* Ujvári, 2010
 - Setae J1 not reaching insertion of J2, j3 pilose *ornatus* (Berlese, 1904)
- 26. Postero-lateral tips of peritrematal shield reaching beyond R5 *banazensis* Urhan, Karaca & Duran, 2015
 - Postero-lateral tips of peritrematal shield not reaching beyond R5 27
- 27. Setae J2 and J3 reaching insertion of following setae *escalai* Moraza, 1988
 - Setae J2 and J3 not reaching insertion of following setae *didimensis* Keçeci, Urhan & Karaca, 2021

DISCUSSION

Members of the genus *Prozercon* are rather small predators living in soil and leaf litter (Mašán and Fend'a 2004). They are non-phoretic, which means that their settlement of new territories is slow. However, *Prozercon* inhabits all four regions of the Palearctic realm.

Prozercon plumosus has been recorded from Romania (Iași and Prahova counties) (Călugăr 2004) and from Türkiye (Duran et al. 2017). In this paper, we present the first record from Slovakia (Bratislava), which is the most northern occurrence.

Morphologically, the species most similar to *P. plumosus* in Slovakia is *P. traegardhi*. The distinguishing characteristic is in the *j5* setal pair, which is pilose in *P. plumosus* and smooth and needle-like in *P. traegardhi*. The pilosity of setae *j5* in *P. plumosus* is very fine and can be overlooked. In addition, most determination keys focus on the opisthonotal setae. These two factors can lead to misidentification.

Prozercon plumosus and *P. traegardhi* were collected in the same soil samples in Slovakia, possibly sharing a similar area. In Slovakia, *P. traegardhi* is distributed from lowlands up to the montane zone. It is most abundant in heterogeneous non-woodland and woodland habitats such as littoral reed growths, alluvial stands, meadows, orchards, glades and forests, and both dry deciduous and humid coniferous (Mašán and Fend'a 2004). *Prozercon plumosus* has been collected so far from soil and leaf litter in deciduous, coniferous, and mixed forests habitats (Călugăr 2004; Duran et al. 2017). Specimens from Slovakia and Türkiye (Güveççi) were collected from leaf litter and soil under pine trees. Romanian specimens were collected from leaf litter and soil in oak forest (Mârzești) and from oak and hornbeam forest (Păulești, Dârvari, Valea Călugărească). The altitudes of recorded localities of *P. plumosus* in Slovakia and Romania are both rather low in comparison with localities from Türkiye. In Romania, localities are no higher than 300 m above sea level (Călugăr 2004), and in Slovakia they are at 170 m. Localities in Türkiye are above 1130 m (Duran et al. 2017).

Prozercon graecus is the only other species, alongside *P. plumosus*, in which females have a pilose setal pair *j5*. These two species can be distinguished by the length of their peritremal shield. The postero-lateral tips of the peritremal shield in *P. plumosus* reach setae R2, whereas in *P. graecus*, the postero-lateral tips of the peritremal shield reach between the R6–R7 setae (setae originally marked as R5–R6) (Ujvári 2011).

The position of the opisthonotal pore *Po1* is also important. In *P. traegardi* and *P. graecus*, the *Po1* pore is near the *Z1* seta on the outer side, while in *P. plumosus* this pore is near the *Z1* seta on the inner side. Additionally, the sternal shield in *P. graecus* provides a weakly sclerotised band between setal pairs *st1* and *st2*, whereas in *P. plumosus* the sternal shield is well sclerotised.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: MJ. Formal analysis: LŠ. Methodology: MJ, LŠ. Visualization: MJ, LŠ. Project administration: PF. Software: MJ, LŠ, PF. Writing – original draft: MJ. Writing – review and editing: LŠ, PF.

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Data availability

All data that support the findings of this study are available in the main text.

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